Lab- 1- Ecology

Environment: is the physical, chemical and biological factors that surrounding the organism in any time.

Ecology: is the scientific study of the distribution, abundance and relations of organisms and their interactions with the environment.

Components of Environment

1- Hydrosphere: includes all water bodies such as lakes, ponds, rivers, streams and ocean etc. Hydrosphere functions in a cyclic nature, which is termed as hydrological cycle or water cycle.

2- Lithosphere: means the mantle of rocks constituting the earth's crust. Lithosphere mainly, contains soil, earth, rocks, mountain etc. Lithosphere is divided into three layers-crusts, mantle and core.

3- Atmosphere: The cover of the air, that envelope the earth is known as the atmosphere. Atmosphere is layer which contains gases like, O2, Co2 etc. and protects the solid earth and human from the harmful radiations of the sun. Atmosphere includes five layers: troposphere, stratosphere, mesosphere, thermosphere and exosphere.

4- Biosphere: known as the life layer, it refers to all organisms on the earth's surface and their interaction with water and air.

Ecosystem: is the ecological unit consisting of biotic factors (living) and abiotic factors (non-living) in a specific area. For example forest, grassland, desert, aquatic etc.

Structure of an Ecosystem

An ecosystem has two types of components:

1. Abiotic (Physical and chemical environment).

2. Biotic (Living organisms).

1. Abiotic component includes:

(A) Physical

(1) Sunlight (for photosynthesis)

(2) Water (essential for living beings)

(3) Temperature (necessary to get survive)

(4) Soil (provide base and nutrients)

(B) Chemical

(1) Proteins (2) Carbohydrates

(3) Fats (4) Minerals etc.

2. Biotic component

(1) Producers: are organisms which prepare organic compounds from inorganic raw materials, through the processes of photosynthesis e.g. all green plants.

(2) Consumer: are organisms which depend on the energy, produced by the producer. Different categories of consumer are herbivores, carnivores and omnivores.

(3) Decomposers: are organisms that attack on dead animals and plants, and convert the complex organic compounds in to simpler compounds (by the process of decomposition) and then recycle all the nutrients back. For example bacteria and fungi.

(4) Scavengers: feed on already dead animals. Ex: vulture, coyote

Importance of atmosphere

1- Contain Co2 and O2 which used in photosynthesis and respiration.
2- Contain N2 which represent basic structure in DNA & RNA.
3- Regulate temperature on the earth and reduce the effect of infrared (I.R.) & ultra violet light (U.V.).
4- Contain ozone layer that prevent U.V. and reduce cancer.
5- Give the blue color of the sky by distracting the solar spectrum radiology.

Importance of hydrosphere

1- Water is a part of living cells.
2- Climate regulating.
3- Human needs.
4- Water provides a habitat.

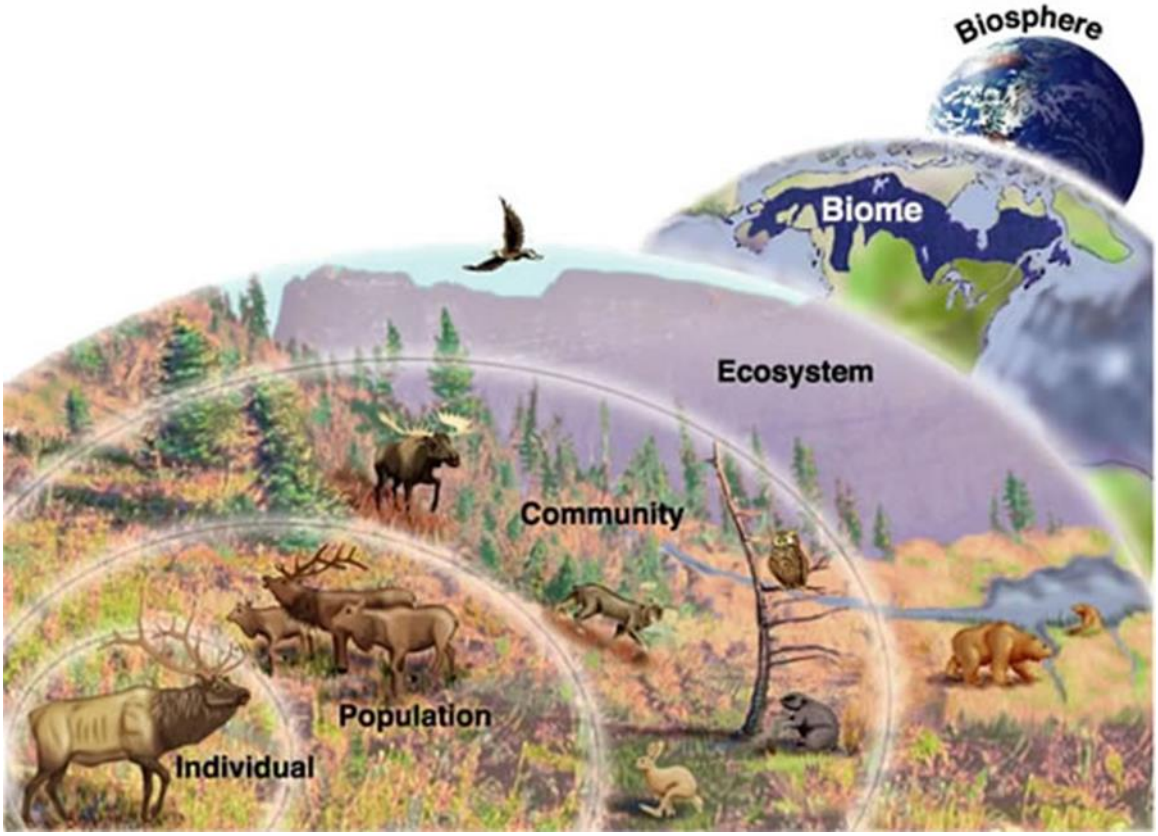
Importance of lithosphere

1- Source of minerals.
2- Source of fuels.
3- Lithosphere with hydrosphere and atmosphere play important role in growth of plants and animals.

Lab-2- Ecosystem

Levels of organization in an ecosystem

1- **Individual:** is any living organism. Individuals do not breed with individuals from other groups.
2- **Population:** a group of individuals of a given species that live in a specific geographic area at a given time.
3- **Community:** includes all the populations in a specific area at a given time. A community includes populations of organisms of different species.
4- **Ecosystem:** include more than a community of living organisms (abiotic) interacting with the environment (abiotic).
5- **Biome**: are very large ecological areas on the earth's surface, with fauna and flora (animals and plants) adapting to their environment.
6- **Biosphere:** is the sum of all the ecosystems established on planet Earth.



Types of biomes

1- **Desert Biomes:** are the Hot and Dry Deserts, Semi-Arid Deserts, Coastal Deserts and Cold Deserts**.**
2- **Aquatic Biomes:** are grouped into two, Freshwater Biomes (lakes and ponds, rivers and streams, wetlands) and Marine Biomes (oceans, coral reefs and estuaries).
3- **Forest Biomes:** There are three main biomes that make up Forest Biomes. These are the Tropical Rainforest, Temperate and Boreal Forests.
4- **Grassland Biomes:** There are two main types of grassland biomes: the Savanna Grasslands and the Temperate Grasslands.
5- **The Tundra Biomes:** There are two major tundra biomes—The Arctic Tundra and the Alpine Tundra.

Importance of biome

1- Help regulate of climate.
2- Enrich the air with oxygen and absorb carbon dioxide and other bad gases from the air.
3- Biome plays a very important role in climate formation.
4- Source of the water cycle.

Food chain is a linear sequence of organisms through which nutrients and energy pass from one organism to another.

Food web: a group of food chains which form complex relationship.

Trophic level: is transfer of energy from organism in level to organism in other level.

Types of trophic levels

Level 1: Plants and algae make their own food and are called primary producers.

Level 2: Herbivores eat plants and are called primary consumers.

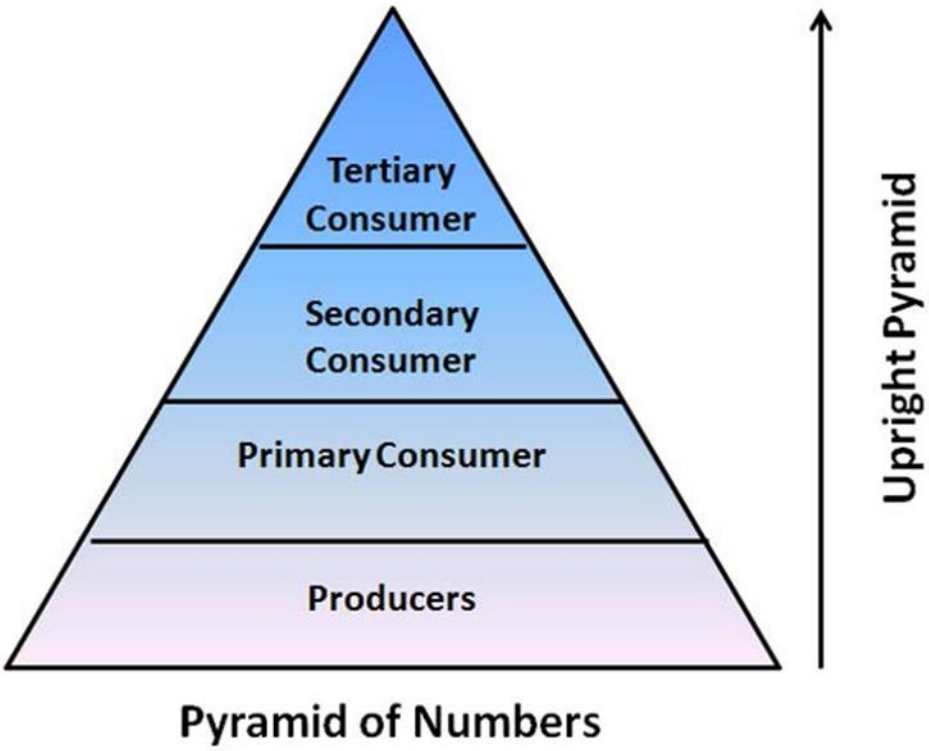
Level 3: Carnivores which eat herbivores are called secondary consumers.

Level 4: Carnivores which eat other carnivores are called tertiary consumers.

Ecological pyramids: are graphical representations of the trophic structure of ecosystems.

Types of Ecological Pyramids

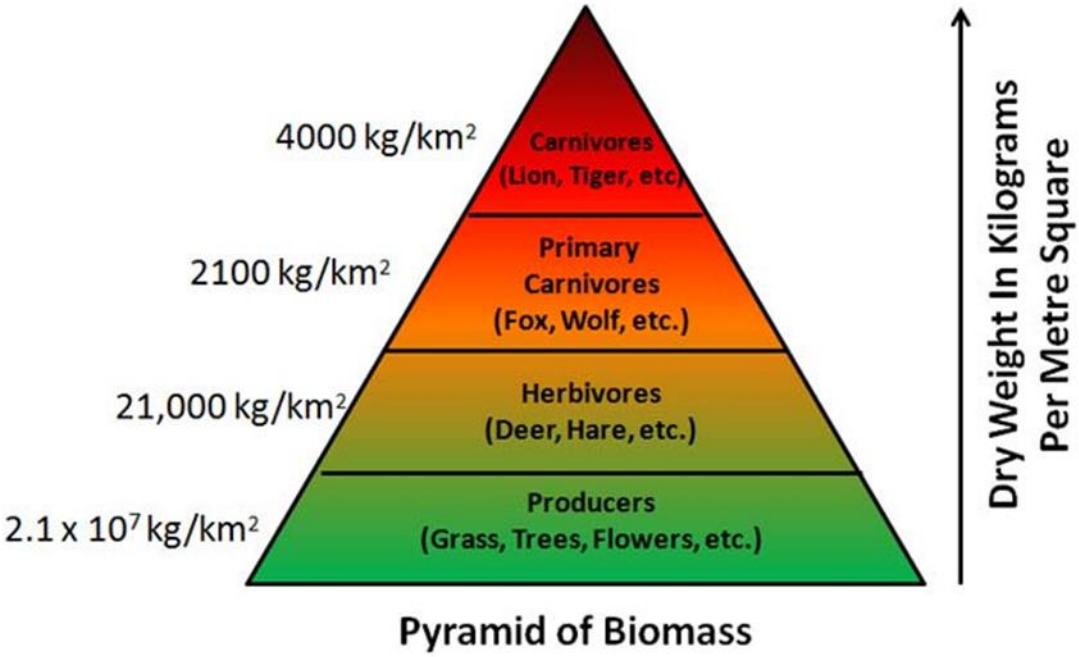
Pyramid of Numbers:



Pyramid of Numbers

2. Pyramid of Biomass:

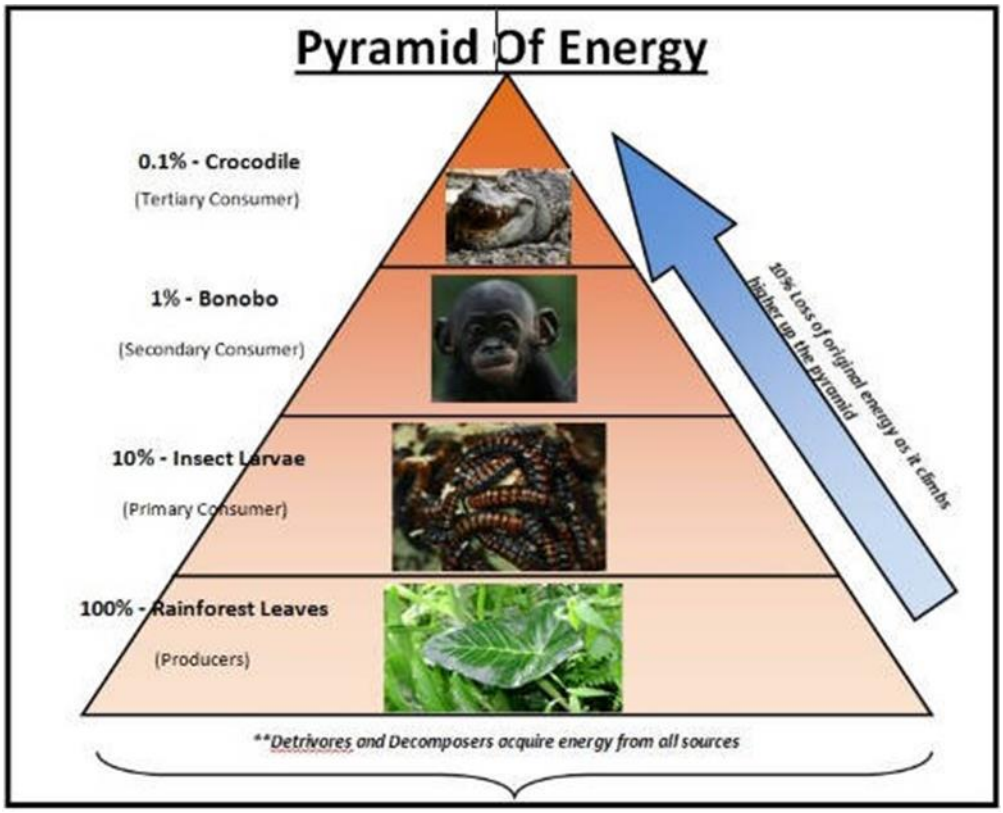
Biomass: is the total mass of all the living organisms in given area.



Pyramid of Biomass

3- Pyramid of Energy:

a graphic representation that shows the amount of energy that is available at each trophic level.



Lab-3- Climate

Climate: is the statistics of weather over long periods of time. It is measured by assessing the patterns of variation in temperature, humidity, atmospheric pressure, wind, precipitation.

Weather: only describes the short-term conditions of these variables in a given region.

Climate change: is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years).

Causes of climate change

1- Biotic processes
2- Solar radiation
3- Plate tectonics
4- Volcanic eruptions
5- Global warming

Climate Classification

A- Tropical Moist Climates: all months have average temperatures above 18° Celsius.

B- Dry Climates: with deficient precipitation during most of the year.

C- Polar Climates: with extremely cold winters and summers.

Factors Influencing the World Climatic Regions:

1) Latitude and its influence on solar radiation received.

2) Air mass influences.

3) Location of high and low pressure zones.

4) Heat exchange from ocean currents.

5) Distribution of mountain barriers.

6) Pattern of prevailing winds.

7) Distribution of land and sea.

8) Altitude.

Global Warming: is the world's average surface temperature increase with the increase in the amount of carbon dioxide, methane and other gases in the atmosphere. These gases are known as greenhouse gases because they contribute to heating the atmosphere, a phenomenon known as global warming.

Expected impacts of global warming:

1 - The occurrence of agricultural disasters and the loss of some crops.

2. Increase forest fires.

3. Increased flooding because large parts of the ice will melt and lead to sea level rise sinking of low islands and coastal cities.

4. Droughts and desertification of large areas of land.

5. Increase the number and intensity of storms and hurricanes.

6 - The spread of infectious diseases in the world.

7 - Extinction of many living organisms.

Greenhouse gases: are gases found in the atmosphere that are able to absorb the radiation lost by the Earth (infrared) and reduce the loss of heat from the Earth to space, which helps to warm the atmosphere of the Earth and thus contribute to global warming.

Greenhouse gases are:

1- Water vapor: It is produced from evaporation processes for water.

2- Carbon dioxide (CO2): It is the result of fuel combustion and any source of smoke such as car exhaust.

3- Nitrous oxides (NOx).

4. Methane (CH4): Methane is produced from livestock.

5- Ozone (O3).

6. Chlorofluorocarbons (CFCs): these have been used in the past for cooling refrigerators.

Lab-4- A biotic factors

Abiotic factors: are nonliving (physical and chemical) factors in an ecosystem. As part of the ecosystem, these factors do affect the living things in it.

Examples of Abiotic Factors: common examples of abiotic factors include:

1- Wind 2- Rain 3- Humidity

4- Latitude 5- Temperature 6- Altitude

7- Soil composition 8- Salinity (the concentration of salt in water)

9- Radiation 10- Pollution 11- Atmospheric pressure

12- Solar radiation

Wind: a moving of air mass due to disruption in air pressure and change direction it from high pressure area to low pressure area and measured by units' **m/s** or **Km/ hr**. or **Knot = 0.515 m/s = 1.84 Km/hr.**

Wind Types

1- Planetary Winds: these winds blowing through-out the year from one latitude to another.

2- Trade Winds: these are extremely steady winds blowing from sub-tropical high pressure areas towards the equatorial low pressure belt.

3- The Westerlies: These winds blow from sub-tropical high pressure belts towards sub-polar low pressure belts.

4- Periodic Winds: change their direction periodically with the change in season, e.g., Monsoons, Land and Sea Breezes, Mountain and Valley Breezes.

5- Local Winds: The local difference in tempera-ture and pressure causes local winds. It is of four types: hot, cold, convectional and slope.

Importance of wind

1- Wind increases the transpiration and intake of CO2.
2- Strong winds affect the plants life both mechanically and physiologically.
3- Under the influence of strong wind the shoots are pressurized and get deformed.

Rain fall: is defined as the water in liquid state or solid forms that fall on the earth and appears as; rain, snow, drizzle, sleet and hail. Also called **precipitation** and measured by **ml.** unit.

Rain Types

1- Convectional rainfall: The surface of the earth is heated by the sun. The warm surface heats the air above it. Hot air always rises so this newly heated air does so. As it rises the air cools and begins to condensate. Further rising and cooling causes a large amount of condensation to occur and rain is formed.

2- Frontal rainfall: two air masses meet, one a warm air mass and one a cold air mass. The lighter, less dense, warm air is forced to rise over the denser, cold air. This causes the warm air to cool and begin to condense. As the warm air is forced to rise further condensation occurs and rain is formed.

3- Orographic rainfall: the prevailing winds pick up moisture from the sea as they travel across it, making the air moist. The moist air reaches the coast and is forced to rise over mountains and hills. This forces the air to cool and condense, forming clouds. The air continues to be forced over the mountains and so it drops its moisture as orographic rain.

Importance of rainfall

1- Rain and snow are part of a larger process called the hydrologic cycle, which transports water from the ocean to land and back again.

2- Precipitation supplies the water that terrestrial organisms need.

3- Some of rainfall meets with ground water to form important source to human through drought.

Humidity: is the amount of water vapor present in the air. There are three main measurements of humidity:

1- Absolute humidity: is the mass of water vapor divided by the mass of dry air at a given temperature and measured by **g/ m3.**

2- Relative humidity: is the water vapor content of the air relative to its content at saturation and measured by **percentage %.**

3- Specific humidity: is the ratio of the mass of water vapor in air parcel to the total mass of the dry air to same parcel and measured by **g/kg.**

Importance of humidity

1- Effect on plants: transpiration, flowering, reproduction and seed germination.

2- Effect on animals: respiration, reproduction, sweating and emigration.

3- Effect on other factors: dew, precipitation and atmospheric pressure.

Lab-5- A biotic factors

Heat: is the amount of energy that transfers from a warmer object to a cooler one. Or is one of energy states and measured by **calories** unit.

Temperature: is a scale of body organism heat and measured by many units; **Celsius scale (°C), Fahrenheit scale (°F), Kelvin scale (K), Reaumur scale (°Re), Delisle scale (°D), Newton scale (°N).**

Temperature conversions

	from Celsius	to Celsius
Fahrenheit	**[°F] = [°C] × 9⁄5 + 32**	**[°C] = ([°F] − 32) ×5⁄9**
Kelvin	**[K] = [°C] + 273.15**	**[°C] = [K] − 273.15**
Delisle	**[°De] = (100 − [°C]) × 3⁄2**	**[°C] = 100 −[°De] × 2⁄3**
Newton	**[°N] = [°C] × 33⁄100**	**[°C] = [°N] × 100⁄33**
Réaumur	**[°Ré] = [°C] × 4⁄5**	**[°C] = [°Ré] × 5⁄4**
Rømer	**[°Rø] = [°C] × 21⁄40 + 7.5**	**[°C] =([°Rø]− 7.5) ×40⁄21**

Importance of temperature

1- Effect of growth, metabolism, sex activity and cell division.

2- Effect on plants: transpiration, hormones activity and nutrient movement.

3- Effect on animals behaviors: hibernation and emigration.

4- Effect on other factors: humidity, wind and evaporation.

Salinity: is the measure of all the salts dissolved in water. Salinity is usually measured in **parts per thousand (ppt).** Salinity is an important factor in determining many aspects of the chemistry of natural waters and of biological processes within it.

Latitude: is a geographic coordinate that specifies the north–south position of a point on the Earth's surface.

Altitude: is a measure of the vertical distance (from bottom to top) between a reference point and another point. The vertical distance from the top to the bottom is called the depth.

Pollution: is the introduction of contaminants into the natural environment that causes adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light.

Radiation: is the emission or transmission of energy in the form of waves or particles through space or through a material medium.

Types of Radiation

1- Electromagnetic radiation: such as radio waves, microwaves, visible light, x-rays, and gamma radiation (γ).

2- Particle radiation: such as alpha radiation (α), beta radiation (β), and neutron radiation.

3- Acoustic radiation: such as ultrasound and seismic waves (dependent on a physical transmission medium).

4- Gravitational radiation: radiation that takes the form of gravitational waves.

Visible light: is a very narrow range of electromagnetic radiation of a wavelength that is visible to the human eye, between 380–750 nm.

Infrared (IR) light: is electromagnetic radiation with a wavelength larger than 750nm. Sun light consists of 53% infrared radiation, 44% is visible light and 3% is ultraviolet radiation.

Microwaves: are electromagnetic waves with wavelengths ranging from as short as one millimeter to as long as one meter.

Radio waves: Is a type of electromagnetic radiation with wavelengths in the electromagnetic spectrum longer than infrared light.

Ultraviolet (UV): is an electromagnetic radiation with a wavelength from 10 nm to 400 nm, shorter than that of visible light.

Lab-6- Atmospheric pressure

Atmospheric pressure: is defined as the force per unit area exerted against a surface by the weight of the air above that surface and measured by units: **Dyne / cm2** or **Newton / m2** and **Millibar.**

Factors that effect on atmospheric pressure

1- Rise and fall above sea level
2- Temperature
3- Water vapor
4- Distribution of land and water

Evaporation: is the transition from liquid to gaseous state and measured by **ml. unit.**

Evapotranspiration: is the sum of water loss of any region as result of the combined effect of evaporation from the soil and water surface and transpiration from plants.

Factors effect on evaporation

1- Climactic factors: water, temperature, wind, humidity and atmospheric pressure.
2- Water state: salinity, water depth and water surface area.
3- Soil state: soil humidity, soil color and vegetation.

Distribution of plants based on its water needs:

1- **Hydrophytes:** are plants that grow in water ex.: *Ceratophyllum.*
2- **Mesophytes:** are plants that grow in medium humidity environment ex.: most land plants.
3- **Xerophytes:** are plants that grow in dry environment (desert) ex.: *Alhagi.*
4- **Hygrophytes:** are plants that grow in high humidity environment (forest) ex.: forest plants.
5- **Halophytes:** are plants that grow in salty land which contain high amount of water soluble salt ex.: *Atriplex.*

Light or solar irradiance: is the power per unit area received from the Sun in the form of electromagnetic radiation in the wavelength range and measured by **Watt-hour per square meter (Wh/m2)** and **kilo Watt per square meter (kW/ m2).**

Importance of light or solar irradiance

1- Source of energy for photosynthesis and chlorophyll synthesis
2- Important in processes of transpiration, flowering, germination and hormones formation
3- Important factor in the occurrence of migration for animals and in the reproduction in mammals and birds
4- Source for heating and maintain body temperature in different regions
5- Interferes with other factors such as humidity and heat which effect on the structure of organisms

There are several measured types of solar irradiance.

Total Solar Irradiance: is a measure of the solar power over all wavelengths per unit area on the Earth's upper atmosphere.

Diffuse Horizontal Irradiance: is the radiation at the Earth's surface from light scattered by the atmosphere**.**

Global Horizontal Irradiance: is the total irradiance from the sun on a horizontal surface on Earth.

The amount of solar radiation that reaches any one spot on the Earth's surface varies according to:

1- Geographic location
2- Time of day
3- Season
4- Local landscape
5- Local weather.

Sun light passes through the atmosphere, some of it is absorbed, scattered, and reflected by:

1- Air molecules
2- Water vapor
3- Clouds
4- Dust
5- Pollutants
6- Forest fires
7- Volcanoes

Lab-7- Vegetation or Plant Cover

Vegetation: is a general term for the plant life of a region; it refers to the ground cover provided by plants, and is, by far, the most abundant biotic element of the biosphere.

Importance of vegetation

1-Vegetation is a key component of an ecosystem and is involved in the regulation of various biogeochemical cycles, e.g., water, carbon, nitrogen.

2- Vegetation converts solar energy into biomass and forms the base of all food chains.

3-Vegetation provides wildlife habitat and food.

4-Vegetation can be used to: monitor changes in cover, composition, and structure due to natural or human-influenced events.

Vegetation types

1- **Natural vegetation:** is vegetation formed in purely natural conditions without any trace of human intervention such as: forests, grasslands and desert formations.
2- **Un- natural vegetation:** is vegetation result from human intervention and use to economic purposes such as farms and fields planted.
3- **Semi-natural vegetation:** plays a major role in the supply of ecosystem services such as pollination, pest control, water quality control and erosion prevention.

Environmental methods used to vegetation study:

1- Quadrates method.
2- Sectors or transects.
3- Photography method.

Quadrates method: Is a method based on taking a square area of a particular area of vegetation to study the composition and characteristics of the plant cover and each square area represents part of the total area of the cover and the study of the largest possible number of squares we get a clear picture of that vegetation.

Advantages of quadrates method

1- Count the number of each type inside the quadrate.
2- Abundance knowledge and importance of each type.
3- Knowledge of the real differences in composition of vegetation.
4- Registration and follow up differences in growth of vegetation.

Vegetation characters

1- Quantitative characters: Frequency, Abundance, Density, Cover, Dominance.
2- Qualitative characters: stratification, periodicity, vitality, constancy.

Frequency (F): Number of models in which the species / total number of models appeared X100

Abundance (A): The total number of individuals of the species / number of models in which the species appeared X100

Density (D): Total number of individuals of species / unit of total area.

(H.W.): Afield study was conducted to 25 models (0.5m2 model area) one species of plants appeared in 15 models; Note that the number of individuals in species is 10 per individuals and total area 75m. Calculate: F (Frequency), A (Abundance) of species.

Lab-8- Soil or Pedosphere

Soil: is the outermost layer of the Earth that is composed of soil and subject to soil formation processes.

Functions of soil

1- It is a medium for plant growth

2- It is a mean of water storage, supply and purification

3- It is a habitat for organisms; all of which, in turn, modify the soil.

Soil components

1- Mineral: the largest component of soil is the mineral portion, which makes up approximately 45% to 49% of the volume.

2- Water: is the second basic component of soil. Water can make up approximately 2% to 50% of the soil volume. Water is important for transporting nutrients to growing plants and soil organisms and for facilitating both biological and chemical decomposition.

3- Organic matter: is the next basic component that is found in soils at levels of approximately 1% to 5%. Organic matter is derived from dead plants and animals and as such has a high capacity to hold onto and/or provide the essential elements and water for plant growth.

4- Gases: gases or air is the next basic component of soil. Because air can occupy the same spaces as water, it can make up approximately 2% to 50% of the soil volume.

5- Microorganisms: are the final basic element of soils, and they are found in the soil in very high numbers but make up much less than 1% of the soil volume. Microorganisms are the primary decomposers of raw organic matter. Decomposers consume organic matter, water, and air to recycle raw organic matter into humus, which is rich in readily available plant nutrients.

Soil types

1- Sandy soil: have the largest particles among the different soil types. It's dry and rough to the touch, and because the particles have large spaces between them, it can't keep on to water and water drains rapidly.

2- Silt soil: has much smaller particles than sandy soil, its smooth touch. Silt soil retains water longer, but it can't keep on to as much nutrients though it's fairly fertile. Due to its moisture quality, silt soil is cold and drains poorly.

3- Clay soil: have the smallest particles among the three so it has good water storage qualities. It's sticky to the touch when be wet and smooth when be dry. Due to the tiny size of its particles, air passes little through its spaces. Also slow drain. Clay soil is rich in plant food for better growth.

4- Peaty soil: is dark brown or black in color, soft, easily compressed due to its high water content, and rich in organic matter.

5- Saline Soil: the soil in extremely dry regions is usually brackish because of its high salt content. Known as saline soil, it can cause damage to plant growth, impede germination, and cause difficulties in irrigation.

Humus: is the organic material in soil, humus is not a form of soil, rather it is the broken down remains of leaves, grass and other organic matter contained within the soil.

Benefits of humus

1- The dark color of humus helps to warm up cold soils in spring.
2- The process that converts raw organic matter into humus feeds the soil population of microorganisms, thus maintains high healthy levels for soil life.
3- Humus plays a hormonal role rather than simply a nutritional role in plant physiology.
4- The rate at which raw organic matter is converted into humus promotes the coexistence of plants, animals, and microbes in soil.

Lab-9- Physical properties of the soil

1- Horizonation 2- Soil color 3- Soil texture

4- Soil structure 5- Soil porosity 6- Bulk density

7- Soil permeability

1- Soil horizons: are layers that make up a soil profile. They are typically parallel with the ground surface; they show evidence of the actions of the soil forming processes.

O horizon: are dominated by organic material. Some are saturated with water for long periods but others have never been saturated.

A horizon: are mineral layers that formed at the surface or below an O horizon, that exhibit obliteration much of the original rock structure.

E horizon: are mineral layers that exhibit the loss of silicate, iron, aluminum, humus. These horizons exhibit obliteration of the original rock structure.

B horizon: are mineral layers that typically form below an A, E and O horizon.

C horizon: are mineral layers which are not bedrock and are little, lack properties of O, A, E or B horizons.

R horizons: are layers of hard bedrock.

2- Soil color: reflect components of soil mineral and chemical composition and extent of organic material. Soils that have dark color are rich in organic materials and fertile and high productivity. Soils of light color are poor to organic materials and low productivity. Soils which slanted to color yellow rich in sulfur, while soils which slanted to white color rich in calcareous material.

Experiment of soil color

Materials: soil samples, casserole dish, Munssel's color chart

1- Take soil samples from different regions and put it in ceramic plate which contains several small pits.

2- Compare the color of each sample with the main colors in munssel's chart
3- If the list of the main colors of the soil above is not provided compare the sample with colors below:

Brown, dark brown, red, yellow, black, dark black, white

3- Soil texture: refers to size and type of particles that make up the soil.

Gravel - particles greater than 2 mm in diameter

Coarse sand - particles larger than 0. 2 mm and less than 2 mm in diameter

Fine sand - particles between 0.02 mm and 0.2 mm in diameter

Silt - particles between 0.002 mm and 0.02 mm in diameter

Clay - particles less than 0.002 mm in diameter

4- Soil structure: describes the way the sand, silt and clay particles are clumped together. Organic matter (decaying plants and animals) and soil organisms like earthworms and bacteria influence soil structure. Clays, organic matter and materials excreted by soil organisms bind the soil particles together to form aggregates. Soil structure is important for plant growth, regulating the movement of air and water, influencing root development and affecting nutrient availability.

5- Soil porosity: refers to the pores within the soil. Porosity influences the movement of air and water. Healthy soils have many pores between and within the aggregates.

Experiment of soil porosity

Materials: graduated cylinder number (2), soil samples

1- Take a graduated cylinder with a capacity of 100 ml. and fill it with 50 ml. water
2- Take another graduated cylinder with a capacity of 100ml. and put in it 30gr. Soil then knock it gently to ensure the stability of the granules and the expulsion of the interspaces
3- Add all the water to the soil sample gradually with constant stirring for 30min. to get rid of air bubbles

4- Calculate the remaining volume of water above the soil surface by the following law:

The amount of water absorbed= amount of original water - amount of water remaining above the soil surface

6- Bulk density: is the mass of soil per unit volume of soil (volume includes both soil and pores)

7- Soil permeability: is the ability of the soil to transmit water and air and measured by (cm per hour, cm per day, cm per sec.).

Chemical properties of the soil

1- **PH:** is defined as the negative log of the hydrogen ion activity PH= - log (+H) and estimate by the following methods:
   A- Colorimetric method
   B- PH meter
2- **Electrical conductivity:** is the sum of negative and positive ions in the soil solution, and measured by **deci-Siemen per meter (dS/m)** and **Micro-siemen per centimeter (Ms/cm).**
3- Salinity: is the total concentration of all dissolved salts in soil.
4- Carbonate content in the soil.